Delayed Onset Muscle Soreness At One Day After One-leg Eccentric Cycling In Relation To Decreases In Muscle Function Immediately Post-exercise

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Introduction

Delayed onset muscle soreness (DOMS) is induced after performing unaccustomed eccentric exercise, but its magnitude is not necessarily associated with the decrease in muscle function immediately post-exercise for the elbow flexors (Nosaka et al. 2006). No previous study has investigated those associations in the knee extensors after eccentric cycling.

This study investigated the relationship between muscle function decrease at immediately post-exercise and DOMS at 24 h after eccentric cycling.

Methods

Eight men and five women (18-47 y) performed 10 revolutions of 1-min (50 rpm) right-legged eccentric cycling at 80% of their concentric cycling peak torque with a 1-min rest between sets (Fig. 1).

Maximum knee extension and flexion torque at 70º (MVIC70) and 20º (MVIC20), and maximum isokinetic knee extension and flexion torque at 90°/s (MVCON) were measured before and immediately-post exercise (Fig. 2).

Muscle soreness was assessed by a 100-mm visual analog scale (VAS) upon palpation and pressure pain threshold (PPT) for vastus lateralis (VL), rectus femoris (RF) and vastus medialis (VM) before and 24 h post-exercise (Fig. 3).

The study was approved by the local institutional ethics committee, and informed consent was obtained from all participants.

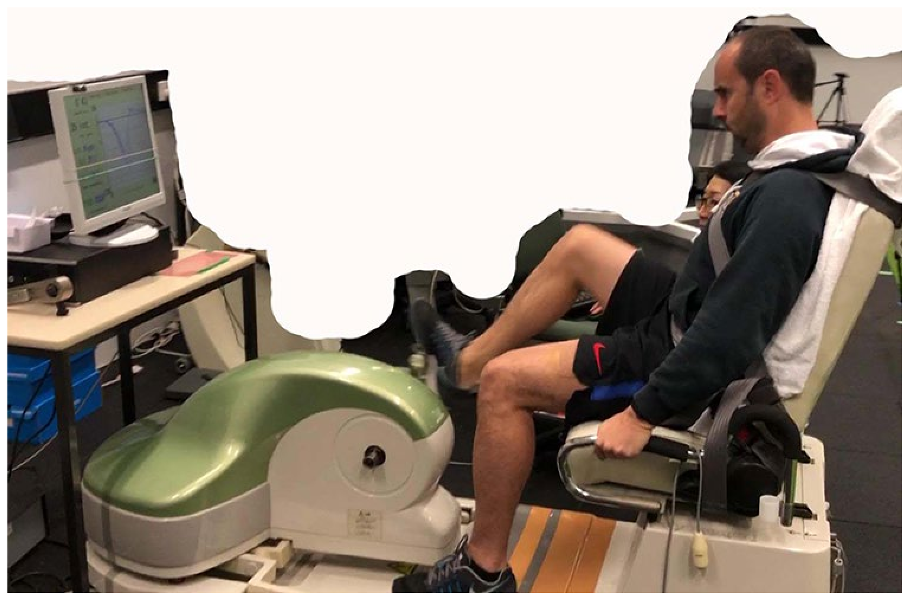

Fig. 1: One-leg eccentric cycling

Fig. 2: Muscle strength tests on a Biodex dynamometer

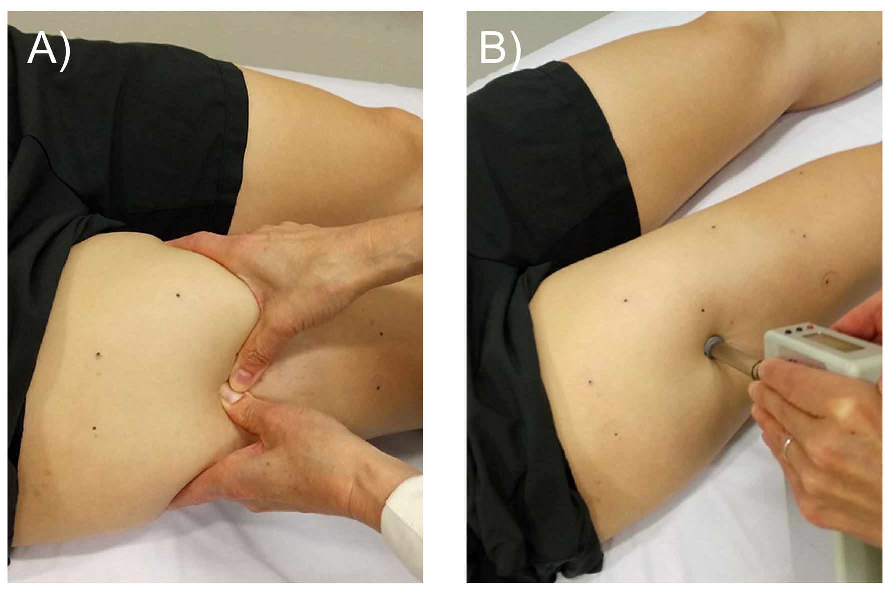

Fig. 3: Muscle soreness assessment using a visual analog scale (A, VAS) and a pressure pain threshold (B, PPT)

Results

No significant changes in knee flexion torque were found, but MVIC70°, MVIC20° and MVCON of the knee extensors decreased 25.1 ± 15.8% (range: 6.5-54.1%), 30.3 ± 18.0% (3.6-62.4%) and 21.4 ± 15.6% (6.1-56.3%), respectively at immediately post-exercise (Table 1), and those torques were still lower than the baseline at 48 hours after eccentric cycling.

At 24 h post-exercise, VAS ranged 0-100 mm for VL (52.8 ± 29.3 mm), RF (47.2 ± 31.6 mm) and VM (48.8 ± 33.5 mm), and PPT decreased 22.3 ± 22.2 (0-59)% for VL, 12.6 ± 22.8 (0-54)% for RF and 20.0 ± 25.9 (0-48)% for VM (Table 1).

The magnitude of changes in MVIC70° and MVIC20° from the baseline at immediately after eccentric cycling significantly ($p<0.05$) related to the VAS (Fig. 4, r=0.69-0.79) and PPT (Fig. 5, r=0.58-0.76) at 24 hours after eccentric cycling.

Spearman's rank correlation coefficient showed a significant ($p<0.05$) correlation between MVIC (20°, 70°) and VAS (r=0.60-0.83) as well as PPT (r=0.60-0.88) for all muscles, and MVCON and VAS for RF (Table 2, Fig. 6).

Table 1. Changes in the criterion measures (range, mean SD, n=13) from baseline to immediately after eccentric cycling in the strength and 24 hours after eccentric cycling in VAS and PPT.

	Range	Mean ± SD
Change in MVIC at 70º (%)	6.5 ~ 54.1	25.1 ± 15.8
Change in MVIC at 20º (%)	3.6 ~ 62.4	30.3 ± 18.0
Change in MVCON (%)	6.1 ~ 56.3	21.4 ± 15.6
VAS for VL at 24 hours after eccentric cycling (mm)	0 ~ 100	52.8 ± 29.3
VAS for RF at 24 hours after eccentric cycling (mm)	0 ~ 100	47.2 ± 31.6
VAS for VM at 24 hours after eccentric cycling (mm)	1 ~ 100	48.8 ± 33.5
Change in PPT of VL at 24 hours after eccentric cycling (%)	0 ~ 59.1	22.3 ± 22.2
Change in PPT of RF at 24 hours after eccentric cycling (%)	0 ~ 53.8	12.6 ± 22.8
Change in PPT of VM at 24 hours after eccentric cycling (%)	0 ~ 48.2	20.0 ± 25.9

MVIC: maximal voluntary isometric contraction strength, MVCON: maximal voluntary isokinetic concentric contraction strength, VAS: visual analog scale, VL: vastus lateralis, RF: rectus femoris, VM: vastus medialis, PPT: pressure pain threshold

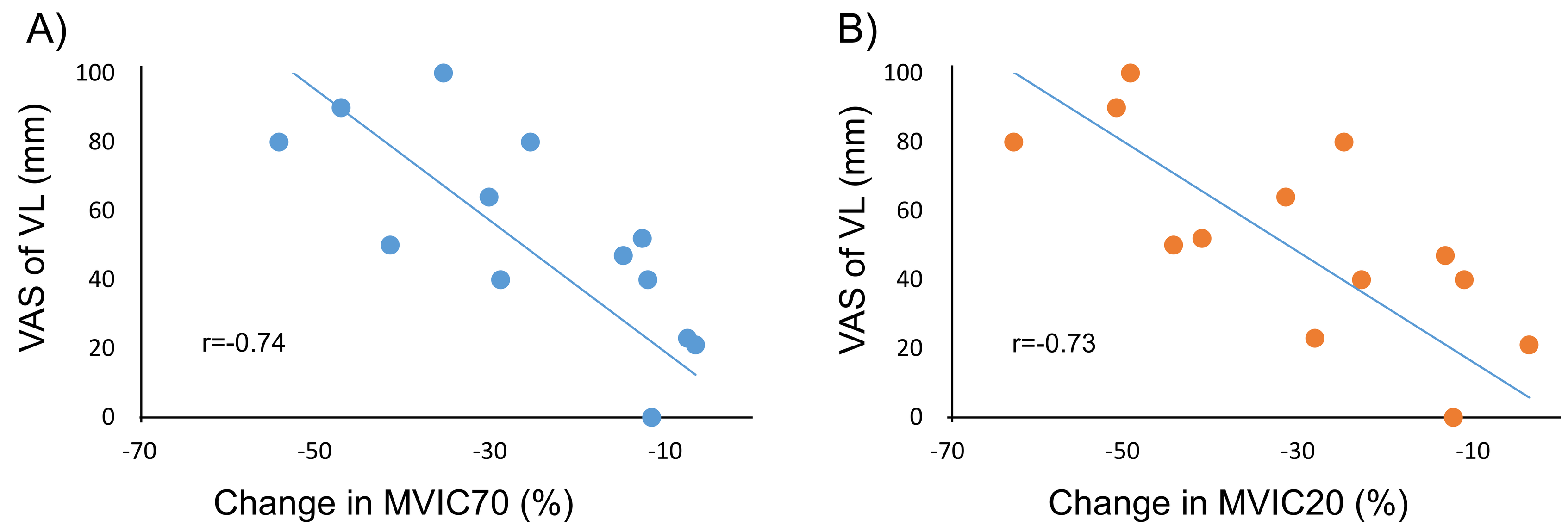

Fig. 4: Correlations between the VAS of VL at 24 hours after eccentric cycling and the magnitude of changes in maximal voluntary isometric contraction strength of the knee extensors at 70° (A) and 20° knee flexion (B) from the baseline at immediately after eccentric cycling.

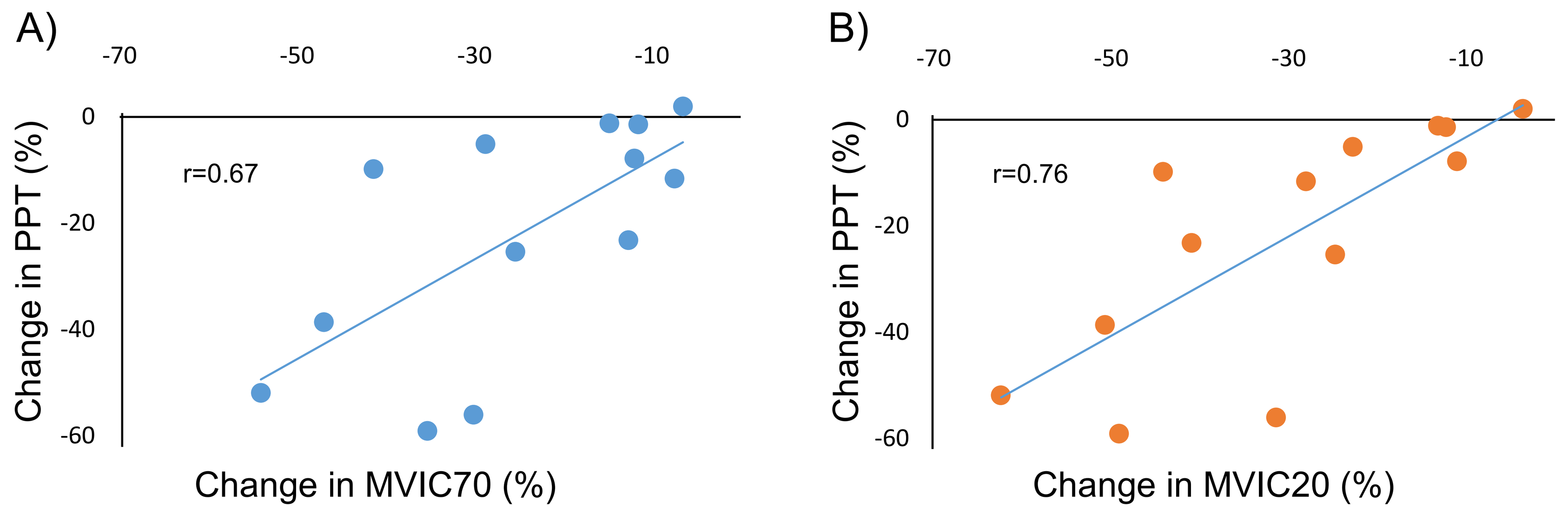

Fig. 5: Correlations between percent changes in PPT of VL at 24 hours after eccentric cycling from the baseline and the magnitude of changes in maximal voluntary isometric contraction strength of the knee extensors at 70 ° (A) and 20 ° (B) from the baseline at immediately after eccentric cycling.

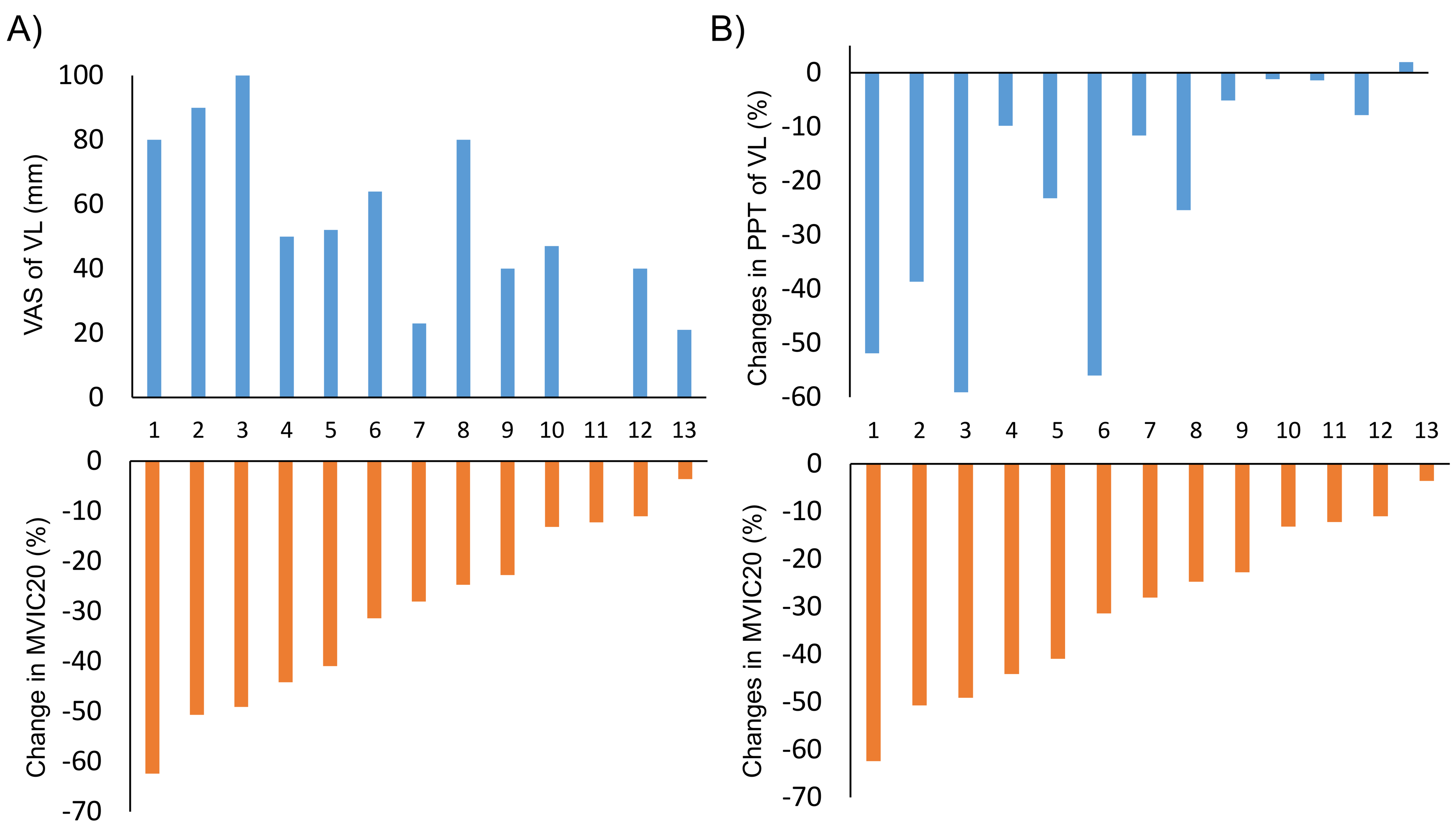

Fig. 6: Relationship between the VAS (A) or PPT (B) of VL at 24 hours after eccentric cycling and the magnitude of change in maximal voluntary isometric contraction strength of the knee extensors at 20º knee flexion (MVIC20) among the participants (1-13). The participants are put in the order of the magnitude of decrease in MVIC20.

Table 2. The correlation coefficients in each factor

	VAS			PPT		
	VL	RF	VM	VL	RF	VM
70ºMVIC	0.830**	0.775**	0.604*	0.665*	0.659*	0.648*
20ºMVIC	0.824**	0.725**	0.704**	0.813**	0.604*	0.883**
MVCON	0.527	0.670*	0.489	0.599	0.786**	0.560

MVIC: maximal voluntary isometric contraction strength, MVCON: maximal voluntary isokinetic concentric contraction strength, VAS: visual analog scale, VL: vastus lateralis, RF: rectus femoris, VM: vastus medialis, PPT: pressure pain threshold, *$p<0.05$, **$p<0.01$

Conclusion

These results suggest that the greater the magnitude of strength loss immediately after eccentric cycling, the greater the DOMS one day later.

The extent of DOMS at 24 hours post-exercise can be predicted from the magnitude of decrease in the muscular strength immediately after eccentric cycling.

Reference

K Nosaka, et al: Is isometric strength loss immediately after eccentric exercise related to changes in indirect markers of muscle damage? (2006) Appl Physiol Nutr Metab 31: 313-9

The authors have no financial conflicts of interest disclose concerning the study.